“There Is No Substitute for Experience”

DOW-KEY MICROWAVE

1U MS, MP, CB Matrix Series

MS-1U18S-4/6-ENET

CAN BUS RF SWITCH MATRIX

Operator’s Manual

Rev 1

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Manual Revision History

The revision history shown below lists all revisions and addendums created for this manual. The revision level increases numerically as the manual undergoes subsequent updates. Addendums are released between revisions and contain important change information that the user should incorporate immediately into the manual. When a new revision is created, all addendum associated with the previous revision of the manual are incorporated into the new revision of the manual. Each new revision includes a revised copy of this history page.

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1 General Information

1.1 Introduction

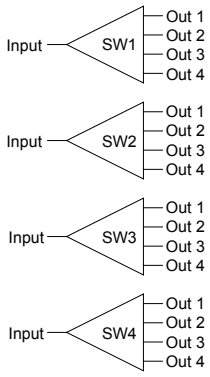
The Dow-Key Microwave 1U MS, MP, CB Switch Matrix series are electromechanical RF matrices. They come equipped with an Ethernet port which allows the user to easily access the matrix from anywhere in the world via TCP/IP on 100BaseT networks. Other interfaces included are an RS-232 port, an USB (used as virtual serial port) and a CAN Bus port. The 1U models are 1 Rack Unit high (1.75”) and come equipped with a keypad and LCD front panel display for manual (Local) operation. These models are not intended to be used to power or control anything other than Dow-Key supplied switches. Connection of other CAN Bus products or other devices not described herein will void quality certifications and the warranty.

This user manual covers all three matrix series since most features are the same among the various models. The user shall focus on the matrix series of interest and skip any section that does not pertain to his matrix.

Information specific to your model (like technical specifications and RF configuration) can be found in appendices at the end of this manual.

1.2 MS Matrices

MS-Series stands for **Multiple Switches**. It is a matrix where a number of independent switches are populated on the rear panel or inside the matrix enclosure. From an RF point of view the switches are not interconnected and all switch's RF ports are available to the user on the rear panel of the matrix. Depending on the size of the switch and the quantities needed, the matrix size can grow from 1RU to 4RU (or even larger).



Example of an MS series matrix with four independent SP4T switches.

Part Numbering Examples:

MS-1U18S-4/X-ENET Is a **M**ulti **S**witch matrix with following characteristics: 1U, 18 GHz, SMA, 4 transfer switches, ENET

MS-2U26S-4/6T-ENET Is a **M**ulti **S**witch matrix with following characteristics: 2U, 26 GHz, SMA, 4 Terminated SP6T, ENET

MS-4U18N-12/10-ENET Is a **M**ulti **S**witch matrix with following characteristics: 4U, 18 GHz, N connectors,12 SP10T, ENET

The part numbering is interpreted as follows:

MS-[chassis size][frequency][connector]-[number of switches]/[type of switch]-[remote control type]

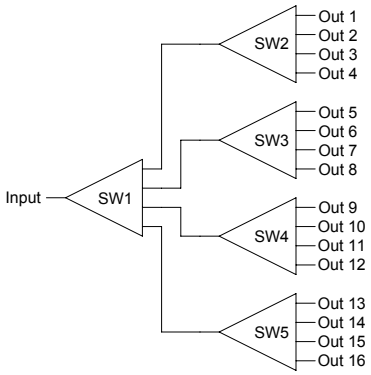
[chassis size]:	1U | 2U | 3U | 4U etc.
[frequency]:	12 (for 12.4 GHz) | 18 (for 18 GHz | 26 (for 26.5 GHz) | 40 (for 40 GHz)
[connector]:	B (for BNC) | N (for N) | S (for SMA) | K (for 2.9 mm)
[number of switches]:	1 | 2 | 3 | 4 | 5 |… |16 (or more if chassis size allows)
[type of switch] :	2T (terminating one port DPDT →terminated SPDT) | X (for DPDT) | 4 (for SP4T) | 6 (for SP6T) | 8 (for SP8T) | 10 (for SP10T) |12 (for SP12T). If switch type is terminated, add 'T' to the number. Example: 6T (terminated SP6T)

[number of switches]/[type of switch]: If different switch types are combined, repeat this section as needed. **Example: MS-1U18S-2/X-2/6T-ENET**

[remote control type]: ENET (for Ethernet, RS-232, USB) | GPIB (for IEEE-488, USB)

1.3 MP Matrices

MP-Series stands for **Multiplexer**. It is a matrix with one input connecting to many outputs (only one at the time) or, since the RF switches are bi-directional, many inputs connected to one output (only one at the time).
The switches are populated either on the rear panel or inside the matrix chassis. From an RF point of view the switches are interconnected and all input/output RF ports are available to the user on the rear panel of the matrix. Depending on the size of the switch and the quantities needed, the matrix size can grow from 1RU to 4RU (or even larger).



Example of an MP series matrix with 1 input/output and 16 outputs/inputs.

Part Numbering Examples:

MP-4U18S-100-GPIB Is a **M**ulti **P**lex matrix with following characteristics: 4U, 18 GHz, SMA, 100 outputs, GPIB

MP-4U18S-20-ENET Is a **M**ulti **P**lex matrix with following characteristics: 4U, 18 GHz, SMA, 20 outputs, ENET

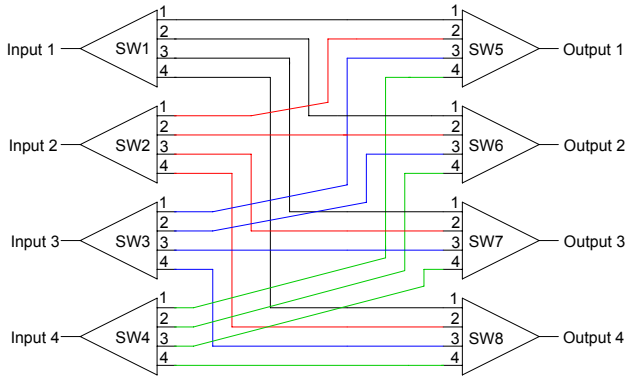
MP-[chassis size][frequency][connector]-[number of ports]-[remote control type]

[chassis size]: 1U | 2U | 3U | 4U etc.
[frequency]: 12 (for 12.4 GHz) | 18 (for 18 GHz) | 26 (for 26.5 GHz) | 40 (for 40 GHz)
[connector]: B (for BNC) | N (for N-type) | S (for SMA) | K (for 2.9 mm)
[number of ports]: 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 (and more ports if chassis size allows)
If ports are internally terminated, add 'T' to the number.
Example: 20T, .. , 100T
[remote control type]: ENET (for Ethernet, RS-232, USB) | GPIB (for IEEE-488, USB)

Note: There is always one only input and a certain number of outputs. So no need to indicate the '1' (for the input).

1.4 CB Matrices

CB-Series stands for **Crossbar**. It is a matrix with several inputs connecting to several outputs. Only one input can be connected to one output at any given time.
The switches are populated inside the matrix chassis and are interconnected so that any input can connect to any output and vice versa. All input/output RF ports are available to the user on the rear panel of the matrix. Depending on the size of the switch and the quantities needed, the matrix size can grow from 1RU to 4RU (or even larger).



Example of a CB series matrix with 4 input and 4outputs.

Part Numbering Examples:

CB-4U18S-10X10-ENET Is a **C**ross**B**ar matrix with following characteristics:
4U, 18 GHz, SMA, 10 inputs 10 outputs, ENET

CB-4U18N-8X8-ENET Is a **C**ross**B**ar matrix with following characteristics:
4U, 18 GHz, N connectors, 8 inputs 8 outputs, ENET

CB-2U18S-4X4-ENET Is a **C**ross**B**ar matrix with following characteristics:
2U, 18 GHz, SMA, 4 inputs 4 outputs, ENET

CB-[chassis size][frequency][connector]-[number of inputs]X[number of outputs]-[remote control type]

[chassis size]:	1U | 2U | 3U | 4U etc.
[frequency]:	12 (for 12.4 GHz) | 18 (for 18 GHz) | 26 (for 26.5 GHz) | 40 (for 40 GHz)
[connector]:	B (for BNC) | N (for N) | S (for SMA) | K (for 2.9 mm)
[number of inputs]:	2 | 3 | 4 | 5 … 10 | 12 | 16| 20 (or more if chassis size allows)
[number of outputs]:	2 | 3 | 4 | 5 … 10 | 12 | 16| 20 (or more if chassis size allows)
[remote control type]:	ENET (for Ethernet, RS-232, USB) | GPIB (for IEEE-488, USB)

1.5 Technical Specifications

Refer to appendix A

1.6 Safety Precaution

Safety precautions should be observed before using this product and any associated instrumentation. This product is intended for use by qualified personnel who recognize the safety precautions required to avoid possible injury.

1.7 Inspection

The Matrices were carefully inspected, both electrically and mechanically before shipment. After unpacking all items from the shipping carton, check for any obvious signs of physical damage that may have occurred during transit. Report any damage to the shipping agent immediately. Save the original packing carton for possible future reshipment. The following items are included with every Model matrix order.

- Switch matrix
- Switch matrix Operation Manual
- Power Cord, Part Number 40203-005

1.8 Maintenance

The matrix requires no periodic maintenance. Should any problems arise, contact Dow-Key Microwave immediately for necessary repairs. These systems are not field repairable.

1.9 Repacking for shipment

Should it become necessary to return the matrices for repair, carefully pack the unit in its original packing carton or the equivalent, and follow these instructions:

- Call the Repair Department at 1-805-650-2327 for a Return Material Authorization (RMA) number.
- Advise as to the warranty status of the matrix.
- Write ATTENTION REPAIR DEPARTMENT and the RMA number on the shipping label.

2 System Layout

2.1 Front Panel Layout

Figure 2-1 shows the 1U Model general layout, which includes:

- 2 handles
- Three LED, LCD and keypad

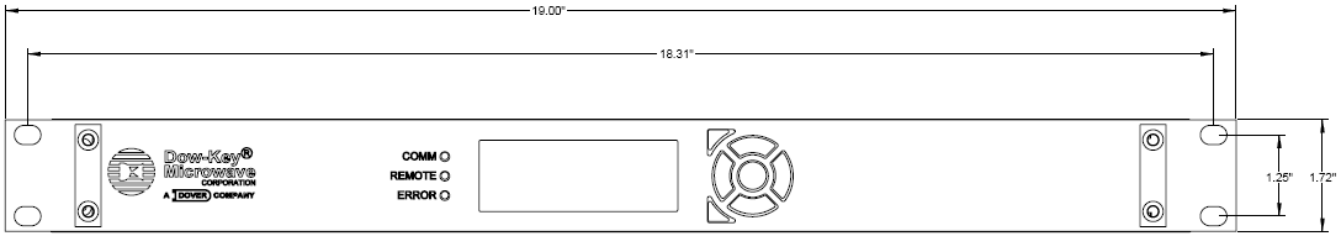


Figure 2-1, 1U Front Panel Layout

2.2 Rear Panel Layout

Figure 2-2 shows an example of a 1U model rear panel general layout. All models have common parts which include:

- Power Entry Module with built in Fuse
- Chassis Ground Post
- 9-Pin D-Sub Female RS232 Connector
- 4-Pin XLR Female CAN Bus / 12V power (output) Connector
- RJ-45 Ethernet Connector
- USB type A Connector

Other parts that are not common to all models are Coaxial RF switches and/or RF connectors.

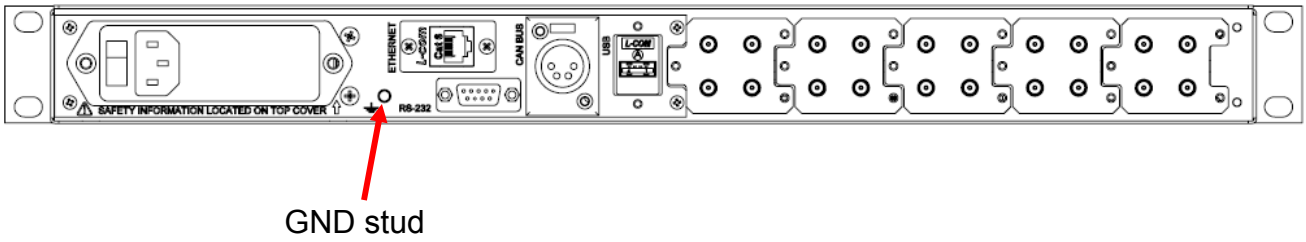


Figure 2-2, 1U MS series (with external switches) Rear Panel Layout

System Layout

2.3 Top View Layout

Figure 2-3 shows the top view layout of all models.

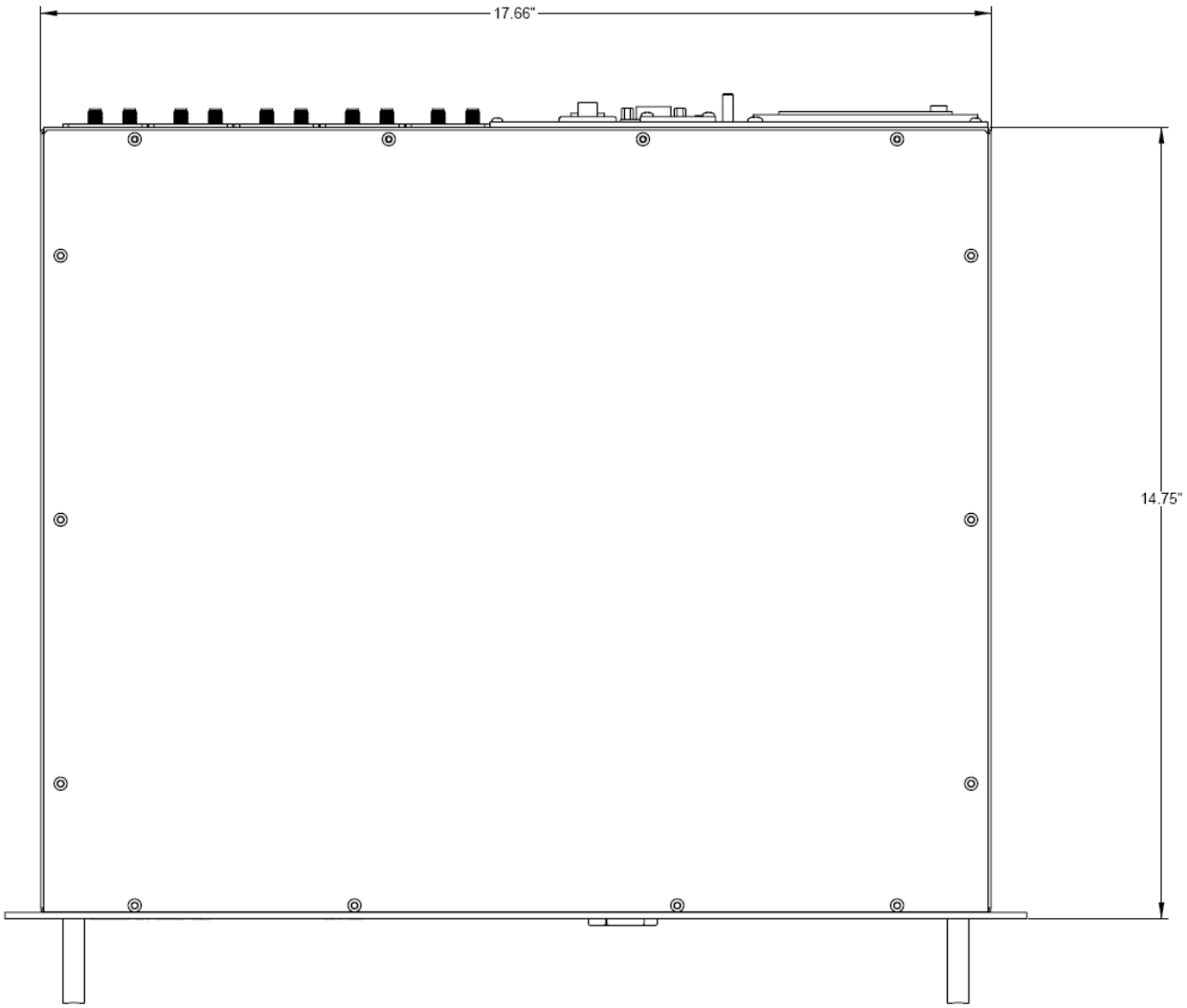


Figure 2-3, Top View of 1U Models

2.4 RF configuration

Refer to appendix B.

3 Connections

3.1 Power Connection

3.1.1 Line Voltage

The matrix operates from a line voltage in the range of 110V to 240V at a frequency of 50 or 60Hz. Line voltage selection is automatic.

CAUTION: Operating the unit on an incorrect line voltage may cause damage, possibly voiding the warranty.

3.1.2 Line Power Connection

Perform the following steps to connect the matrix to line power:

1. Connect the female end of the supplied power cord to a grounded AC receptacle on the rear panel.
2. Connect the other end of the supplied power cord to a grounded AC outlet.

WARNING: The power cord supplied with the matrix contains a separate ground for use with grounded outlets. Failure to use a grounded outlet may result in personal injury or death due to electric shock.

3.1.3 Line Fuse Replacement

A rear panel fuse protects the power line input of the matrix. If the line fuse needs replacement, perform the steps below:

WARNING: Disconnect the line cord from the unit before changing the line fuse.

1. The fuse is located in a holder in the power module unit above the AC receptacle (figure 3-1). At top is a small tab, use a small bladed screwdriver to release the fuse holder.
2. Slide the fuse holder out to gain access to the fuse carrier and fuse.
3. Remove the carrier with the blown fuse, and replace with the correct type listed in Table 3-1.

CAUTION: For continued protection against fire or unit damage, replace the fuse only with the type and rating listed.

4. Install the fuse carrier in the fuse holder, then insert the fuse holder back in the power entry module.

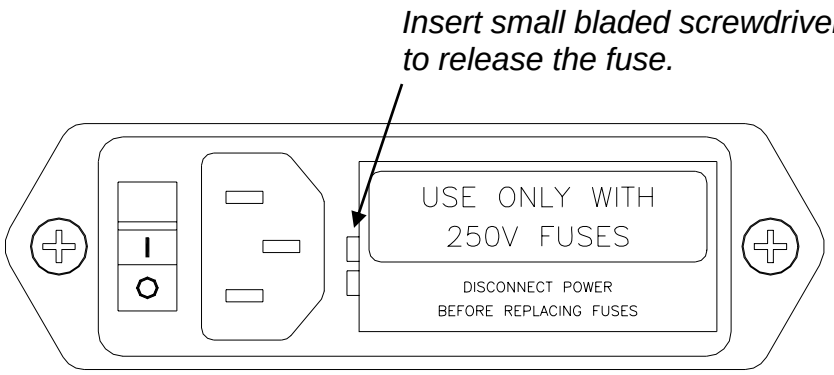


Figure 3-1, Power Entry Module

Line Voltage	Fuse Rating	Manufacturer	Manufacturer Part No.
110-240V	1A, slow blow, 250Vac, ¼" x 1-1/4"	Bel Fuse Inc.	3SB 1-R

Table 3-1, AC Line Fuse Information

3.2 Ground Connection

The rear panel GND ground screw (refer figure 2-2) should be connected to safety earth ground using #18 AWG or larger wire.

3.3 RS232 Connection

The switch matrix may be operated over this connection (See Section 6 for a description of the commands). The RS232 connection is configured with these default settings: 9600 Baud, 8 bit data, no parity, 1 stop bit.

The baud rate can be changed thru the keypad / LCD to:
1200, 2400, 4800, 9600, 19200, 38400, 57600,115200 bits/sec

Figure 3-2 and Table 3-2 show the pin numbers and functions for the RS232 female connector.

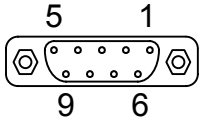


Figure 3-2, RS232 Female Connector Pin Numbers

Pin 1	NC
Pin 2	Transmit
Pin 3	Receive
Pin 4	NC
Pin 5	Ground
Pin 6	NC
Pin 7	NC
Pin 8	NC
Pin 9	NC

Table 3-2, RS232 Female Connector Pin Functions

3.4 CAN Bus Connection

This connection allows the matrix controller to be easily interfaced to another Dow-Key Microwave Switch Extension Matrix, using a one-to-one (straight through) cable. However, the Matrix being interfaced must not have any internal, intelligent controller; it must be a simple RF Switch Extension Matrix. Furthermore, the switches in the extension matrix being interfaced must have CAN ID's unique to any others connected to the matrix. See Section 4 for more information.

Care must also be taken to limit the internal power supply's current draw on the +12 VDC to a maximum of 7 Amps. Note that this includes all switches of the master matrix and the extension matrix combined.

Figure 3-3 and Table 3-3 show the pin numbers and functions for the CAN Bus connector.

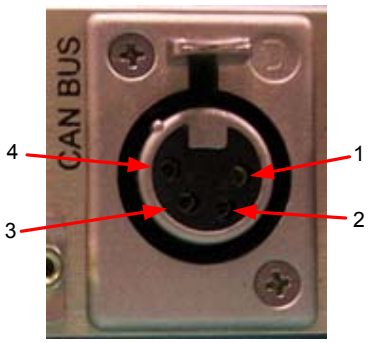


Figure 3-3, CAN Bus Connector Pin Numbers

The mating connector is Deltron 701-0400. The pin outs (embossed on connector faces) are:

1. +12 VDC, 7A max (this current is for master and extension matrices combined. See Individual switch data sheets for current draw).
2. CAN LO
3. CAN HI
4. 12 VDC Return (GND)

Table 3-3, CAN Bus Connector Pin Functions

3.5 Ethernet Connection

The matrix comes equipped with an Ethernet port (RJ45 connector) which allows the user to easily access the matrix from anywhere in the world via TCP/IP on 100BaseT networks. See Section 4 and Section 6 for descriptions regarding how to connect to, configure, and operate the matrix over this 100BaseT Ethernet connection.

3.6 USB Port

Connecting the matrix to a PC's USB port should result in a "Found New Hardware" event. Follow the instructions until prompted for the new hardware device's driver, which may be located on the CD shipped with the matrix.

After installation, the matrix's USB port will appear as a virtual serial port. Communicate to this port as you would on any RS 232 serial port. The baud rate is 9600 b/s. See sections 3.3 and 6 for more details.

4 Configuring the Matrix for Operation

4.1 Matrix Configuration

The 'brain' inside Dow-Key Matrices, referred to as the "Matrix Controller", has been designed to be as general as possible in regards to how many switches of what positions it may control. Therefore, the matrix must first be informed as to the set of switches it is able to control before it can operate successfully, and this information must be updated as switches are added and deleted to the matrix or connected to the CAN bus port on the rear of the matrix (see section 3.4). The knowledge of what switches are to be controlled and how many positions each of those switches has is known as the matrix's Configuration Data.
In addition to switch information, the Matrix Configuration also contains other information such as the base MAC address, unit's Serial Number, alarm enabling, Model Name, etc. This information must remain intact for the matrix to operate properly.

The matrix configuration is already performed at the factory and does not need to be done by the user unless the Matrix Controller board has been replaced.

Adding and removing switches (see sections 5.2.3 and 7.3) automatically updates the matrix configuration. No further action is required by the user

The topics discussed in sections 4.2 and 4.3 are not needed during normal operation of your matrix. These sections are here for informational purpose and in the event the RF configuration of the matrix is being modified by adding/removing switches.

4.2 Dow-Key CAN bus switches

A CAN Bus switch may assume a maximum CAN ID of 127. Individual switches delivered by Dow-Key will be programmed with either ID=0 or ID=1, depending on the particular procedure utilized to manufacture the switch. The matrix provides the means to change CAN Bus ID's at will.

A CAN Bus switch may have a maximum of 255 positions (0 through 254). 255 is reserved as a return value indicating that the switch is either in an erroneous position, or is reported to the Operator to when a switch fails to respond to a query for current position.

A switch whose ID is 0 is referred to as a "zero switch", or also a "0 switch". A switch whose ID is other than 0 is referred to as an "N switch".

Zero switches and N switches have different properties:

Only a zero switch may change into an N switch.

An N switch may not change its ID to anything other than 0.

A zero switch will not respond to commands to change or report its position.

A zero switch will not respond to queries as to switch position closure counts.

A zero switch may not be added to a Configuration (see below) as an ID=0.

4.3 Adding and Deleting Switches

The following rules apply when adding a switch to the Matrix Configuration (the desired ID to add is referred to as the “target ID”):

- The desired switch to ADD must be connected to the matrix before executing the ADD procedure.
- If the connected switch is a 0 switch AND the target ID is not yet configured AND a switch possessing the target ID is not already connected, then the 0 switch will change its ID to the target ID and the Configuration will be updated.
- If the connected switch is a 0 switch AND the target ID is already configured AND a switch possessing the target ID is not already connected, AND the 0 switch’s number-of-positions data matches that of the Configuration’s, then the 0 switch will change its ID to the target ID.
- If the connected switch is an N switch AND the target ID=N is not yet a configured ID, then the N switch will be added, i.e. the Configuration will be updated.
- If the connected switch is an N switch AND the target ID=N is already a configured ID, AND the N switch’s number-of-positions data matches that of the Configuration’s, then the N switch will be added, i.e. the Configuration will be updated (actually, the ID isn’t really added since the ID is already configured, however a Configuration match is performed).

The following rules apply when deleting a switch from the Configuration (the desired ID to delete is referred to as the “target ID”):

- Only an N switch may be deleted from a Configuration; 0’s are not Configurable .
- If the N switch to delete is connected and is not a Configured ID, AND a zero switch is not connected, then the N switch will be returned to a 0 switch.
- If the N switch to delete is connected and is already a Configured ID, AND a zero switch is not connected, then the N switch will be removed from the Configuration and its ID set to 0 (i.e. turning the N switch into a 0 switch).
- If the N switch to delete is connected and is already a Configured ID, AND a zero switch is connected, then the N switch will be removed from the Configuration, but the N switch’s ID will remain N.
- If the N switch to delete is not connected and is already a Configured ID, then the ID will be removed from the Configuration

NOTE:

THE MATRIX MUST BE POWER CYCLED AFTER MAKING ANY CHANGES TO THE CONFIGURATION BEFORE THOSE CHANGES BECOME FULLY APPARENT.

NOTE:
It’s a good idea to keep unused switches stored as 0 switches. Also, if a switch is to be dedicated to a particular CAN Bus ID, it should be marked such on the switch’s enclosure.

Example procedure:

Adding a switch to the Configuration usually starts by finding the ID of the physical switch to add. Select **Main Menu>System Settings>Find Switch ID** and follow the instructions in Section 5.2.3 Find Switch ID. **TAKE NOTE OF THE INFORMATION REGARDING SWITCH FIRMWARE REVISION IN STEP 5**.

If the switch's ID is the one desired to add (0 or N), the switch may be left connected and the BACK key may be pressed to return to the Main Menu. To ADD the switch, select **Main Menu>System Settings>Add Switch.** The LCD will indicate if the switch to add is a 0 switch and then prompt the user with the next available-to-configure ID, or the user may enter a different, un-configured ID.

If the switch's ID is not zero, LCD will prompt to add the next available-to-configure, and the user must enter the connected switch's ID.

Suppose a switch's ID has been found to be N=x, but a 0 switch is required to add the switch as N=y: Therefore the switch's ID must first be changed to zero. With the N=x switch connected AND with NO OTHER N=x SWITCHES CONNECTED, select **Main Menu>System Settings>Delete Switch.** Enter the ID (N=x) of the connected switch, and its ID will be set to 0.

Now the process to add the switch as N=y may be executed via **Main Menu>System Settings>Add Switch.**

Deleting a switch from the matrix configuration data does not require the switch being connected, but when it is its ID will be returned to 0. If it is not connected, it is still removed from the Matrix Configuration Data.

4.4 Configuring the Ethernet Connection

All devices connected to an Ethernet and communicating via TCP/IP must have a unique IP address and TCP Port number.

The DowKey matrices are programmed at the time of its manufacture to have a Dynamic IP address (Dynamic Host Configuration Protocol is ON). See sections 5.2.4 and 6.7 for more details on how to obtain an IP address dynamically or set it manually as static.

When the IP address is obtained dynamically (DHCP is ON) the IP address is displayed for a few seconds at power up. See section 5.2.4 to display the IP address after boot up is completed.

The matrix is programmed at the time of its manufacture to have the following default settings:

- IP Address: obtained dynamically
- TCP Port Number: 10

See Sections 5.2.4 for instructions on how to set the IP Address and TCP Port Numbers to other values.

4.5 Connection to an Ethernet

The use of a standard “Straight Through” Ethernet cable is required to connect the matrices to an Ethernet LAN hub. Connection to a single computer requires the use of “Crossover” Ethernet cable.

4.5 Testing Ethernet Communication

The matrix's ability to communicate should be tested once it has been configured and connected to an Ethernet network.

Connection thru a network:

Assuming the matrix's default IP address setting has not been changed from obtaining the IP address dynamically, take note of its IP address during the boot-up process (or se section 5.2.4 to read its IP address). Assuming the connection has been made with a personal computer connected to the same network and running some version of Microsoft Windows©, select

Start>Run

and type

Ping nnn.nnn.nnn.nnn

where nnn.nnn.nnn.nnn is the matrix IP address previously noted.

Connection to a standalone PC:

If the matrix is connected directly to a standalone PC (rather than a network), set the IP address of the matrix so that the first 3 numbers match the PC's IP address. The last number must be different.

Example:	PC IP address:	200.169.200.180
	Matrix IP address:	200.169.200.181

Assuming the connection has been made with a personal computer running some version of Microsoft Windows©, select

Start>Run

and type

Ping nnn.nnn.nnn.nnn

where nnn.nnn.nnn.nnn is the matrix IP address. In this example 200.169.200.181

In both the above scenarios a valid and working connection will yield a response similar that shown in the example below:

```
C:\>ping 200.169.200.181

Pinging 200.169.200.181with 32 bytes of data:

Reply from 200.169.200.181:  bytes=32  time=5ms  TTL=64
Reply from 200.169.200.181:  bytes=32  time=2ms  TTL=64
Reply from 200.169.200.181:  bytes=32  time=2ms  TTL=64
Reply from 200.169.200.181:  bytes=32  time=3ms  TTL=64

Ping statistics for 200.169.200.181
Packets: Sent=4, Received=4, Lost=0 (0% loss)
Approximate round trip times in milliseconds:
Minimum=2ms, Maximum=5ms, Average=3ms
```

The matrix's Ethernet interface was designed to operate with common network utilities and drivers. If the Matrix fails to communicate, contact your network administrator for additional assistance. If your network administrator is unable to locate the problem, please contact Dow-Key Microwave Corporation at 1-805-650-2327.

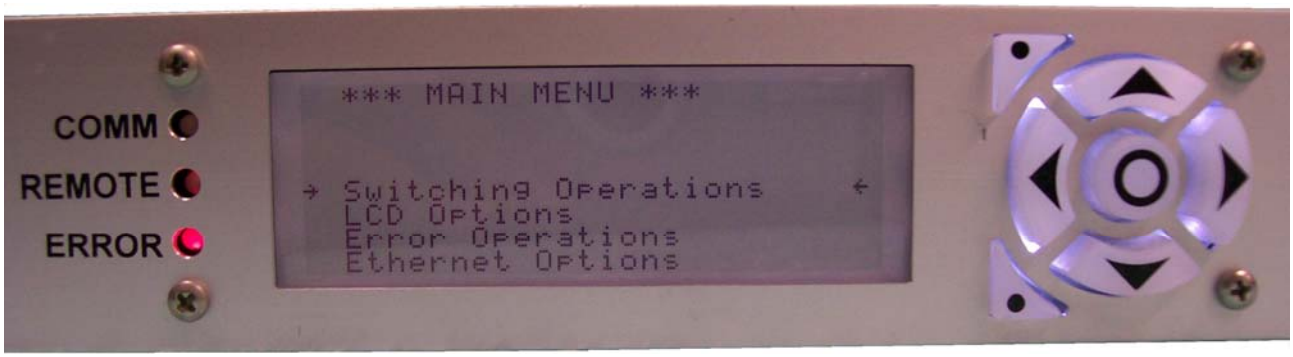
5 Manual (LOCAL) Operation

5.1 The Keypad / LCD Interface

Power On:

Position the rocker switch on the rear panel of the Matrix to the on position (Figure 2-2) to turn on the matrix.

! Note: The booting sequence will last about 15 seconds in which the LCD will appear blank.



The figure above shows the LCD/Keypad (sometimes referred to as the "User Interface", or "UI") at the top level of UI screens.

The "COMM" LED should normally be blinking green as an indication of normal program execution.

The "REMOTE" LED, normally dark, will illuminate green when the matrix is in REMOTE Mode (See Section **Error! Reference source not found.**).

The "ERROR" LED, normally green, will illuminate red upon the occurrence of an error event, or the persistence of several error conditions (see Sections 5.2.2 and 6.5.1).

The LCD in the figure above shows the top level of the operational screen, which happens to be a menu; the keypad is used to scroll through and select menu items. Other screens encountered allow the operator to modify various parameter values; all such "data fields" are presented with a currently set or default value blinking, prompting the operator to modify the value. Some screens present multiple data fields, and the keypad is used to navigate around them.

The keypad's keys have multiple functions depending on which screen is being presented.

The keypad's round, center key is referred to as "ENTER" and serves as "set", "select", "done", or "return".

The keypad's arrow keys (pointing the 4 cardinal directions) are referred to as "UP", "DOWN", "LEFT", and "RIGHT".

UP and DOWN serve as “scroll up”, “scroll down”, “increment”, or “decrement”. Many data fields’ values are modified by UP and DOWN, and many of those allow the pressing and holding of the UP and DOWN keys to cause an acceleration of the incrementing or decrementing.

The keypad’s upper left diagonal key is referred to as UP DIAG. This key serves as “back”, “clear”, or “escape”.

The keypad’s lower left diagonal key causes no action in the context of any screen.

LEFT and RIGHT serve as “next” and “previous”; these keys are used almost exclusively to navigate around the user data entry fields many screens present.

Caveats:
The UI device may demonstrate a “speed limit” when it comes to how rapidly the Operator may actuate keys and still get the correct response on the LCD: the Operator is encouraged to find a comfortable cadence when operating the keypad.

! Note:

To preserve the life of the LCD, it has a ‘screen saver’ feature. After 5 minutes the LCD backlight will turn off. Once dark, pressing any key will have no effect other than to re-illuminate the backlight.

The matrix will power up in LOCAL Operating Mode. LOCAL Operating Mode means that the matrix is receiving commands from the front panel (Keypad).

When in LOCAL Operation Mode the matrix will switch automatically in REMOTE mode as soon as commands coming from a remote control computer are received (Ethernet, Serial or USB). The matrix will return to LOCAL Mode upon the pressing of any key.

The matrix will not accept any other local commands until the operator switches to LOCAL mode by pushing any button on the keypad.

As stated before, to switch to REMOTE Operation Mode the operator needs to send a command (Ethernet, Serial or USB) by means of a remote control computer.

All LOCAL operation of the matrix is accomplished via the front panel’s Keypad / LCD.

The various screens encountered in the matrix’s operation contain the following controls:

5.2 Main Menu

5.2.1 Switching Operations

Switch Operations Menu

Set Switch Positions

View the currently set position and change the position of a switch who's ID has been configured to the matrix. Use the arrows to change switch and position numbers.

Refer to Appendix B to set the RF switches in the correct desired positions.

Current Positions

View the currently set positions of all switches whose ID's have been configured to the matrix. This screen can show a maximum of 12 switches at a time; press UP or DOWN to view the next set of a maximum of 12. Note: the presentation of switch positions is a "one way" experience in that the operator can only view successively greater ID's. BACK will bring the Operator back to the Switching Menu.

Remember that a switch position reported as 255 (0xFF) is meant to mean "position unknown", and is often the result of a switch not responding to a query for position.

Note that all Dow-Key switches have "open" defined but not all switch types have an actual open position (the switch is not closed to any of its RF ports).
For most switches this "open" is the default position and is defined as position 0. But for transfer switches there is no "open" condition, hence the default position is pos.1. As a result of this, commanding the switch to pos 0 or pos 1 will have the same result, closing it to its default position 1.

Switching History

View the last 10 switching actions. The latest action is presented first.

Save Positions

Save to non-volatile memory the state of the positions of all switch ID's configured to the matrix, as 1 through 30.

Recall Positions

Recall from non-volatile memory the state of the positions of all switch ID's configured to the matrix, saved as 1 through 30, and set the positions of those switches.

Clear Positions

Cause all switches configured to the matrix to assume their default position. For most switches this is position 0 (open positions). Note that all Dow-Key switches have "open" defined but not all switch types have an actual open position, such as a transfer switch. In this case "open" means "close on its default position 1".

Cycle Positions

Step all switches configured to the matrix through all of their positions. NOTE: the Cycle Position function is intended for use at the Dow-Key factory during the assembly process. In fact, the Cycle Position function will generate errors when commanding a Transfer switch to switch from position 0 to position 1, which may be ignored. For this reason, the Operator is discouraged from exercising Cycle Positions.

5.2.2 Error Operations

View the contents of the Error Log (see Section 6.5.1). Each entry is displayed with the oldest being first (First In First Out), showing the Error Record Number (its place in the Error Log), an associated Error Code, an associated Error Data, and a text explanation of the Error.

The Error Data contains various parameters associated with certain Errors. For instance, an Error Code 10 “Switch Did Not Respond” will show the offending switch ID in the Error Data field.

Once a particular Error has been logged, no further occurrences of it will be entered. For instance multiple subsequent misspelled Commands, would not result in multiple Syntax Errors being logged until the original entry was cleared.

As each error is being read (displayed locally or queried remotely) it will also be removed, always clearing the oldest remaining entry, from the Error Log. Entries in the Error Buffer are removed by successive presses of the up or down arrow keys.

The Error LED will illuminate green when the Error Log is empty unless a persistent error condition exists, such as a Power Supply failure that remains failed.

5.2.3 System Settings

System Settings Menu

! Important Note:

The matrix controller is designed to offer the maximum expandability and flexibility possible and therefore has features common to other Dow-Key matrix models. The here described 'Add', 'Delete' and 'Find Switch ID' features are some of those that, although available and fully functioning, should only be used if needed and appropriate.

Switches may be added and deleted from the Matrix Configuration using these commands.

For those matrix models with a custom or fixed RF configuration (in other words where the internal RF switches and its connections are defined on a custom bases or are established and fixed by design), no switch shall be added or removed from the matrix configuration. Not following this instruction will result in a non working matrix!

System Information

View the Dow-Key Matrix Product's Model Number, its Serial Number (set at factory), and the Dow-Key part number and revision level of firmware running on the Matrix Controller.

Add Switch

Add switches to the Matrix Configuration (see Sections 4.1, 4.2, 4.3).

Delete Switch

Delete switches from the Matrix Configuration (see Sections 4.1, 4.2, 4.3).

Find Switch ID

Discover and view the ID of any switch by following these steps:

1. Using a matrix with at least one unused CAN Bus connector, and leaving the switch in question unconnected, select **Main Menu>System Settings>Find Switch ID.** The screen will indicate that no switch is connected.

2. Connect the switch in question. The screen will now display the unknown switch ID. NOTE: occasionally, the switch will not immediately report its ID; in this case, simply disconnect and reconnect the switch.

3. Multiple switches may be connected and disconnected one at a time while in this screen.

4. NOTE: this operation “puts the matrix’s switches to sleep” thereby rendering the matrix inoperable during the process. ENTER or CLEAR or rebooting returns the matrix to normal.

5. NOTE: proper performance of Find Switch ID relies on the behavior of Dow-Key Switch firmware revision 4 and above – revision 3 and below does not allow “putting the switch to sleep”. So, this feature is best executed on a matrix that does not contain switches with firmware revision 3 or less, or those switches will respond with their ID’s as well as the switch in question. The revision of firmware of any switch configured to the matrix may be learned with **Main Menu>System Settings>Switch Information** (see below).

Temperatures

View current values of a maximum of 4 temperature sensors, and set thresholds at which an Over Temperature alarm should occur. Setting all 4 alarm thresholds to 0° Celsius disables Over Temperature alarms and causes the current temperatures to read out 0° as well; this is the recommended setting for Matrix Products that contain no temperature sensors.

Most standard Models do not feature temperature sensors.

Switch Closure Counts

View the number of times any position of any switch configured to the matrix has been closed upon, to a maximum of 1,000,000.

Switch Information

View the Part Number, Serial Number, Firmware Number, Firmware Revision Level, maximum number of positions, its PCBA Code (factory), and Coil Delay Time, of any switch configured to the matrix.

Default Settings

This password protected option is used during the assembly process and is not intended for Operator use.

5.2.4 Ethernet Options

Actual changes to the Ethernet variables referred to below will not take effect nor be shown on the front panel until the matrix has been powered down and back up.

See Sections 4 and 6 for more information regarding use of Ethernet to control the matrix.

Ethernet Menu

Set/Acquire IP Address

View and/or modify the current IP Address and Acquisition Mode, Static or Dynamic (DHCP off or on).

Set Subnet Mask

View and/or modify the current Subnet Mask.

Note: the Acquisition Mode needs to be Manually (DHCP = OFF) for this parameter to be changed.

Set Gateway

View and/or modify the current Gateway.

Note: the Acquisition Mode needs to be Manually (DHCP = OFF) for this parameter to be changed.

Set Port Number

View and/or modify the current Port Number. The factory default is 10.

Set Timeout

View and/or modify the current Timeout settings (in seconds). The factory default is 0 seconds.

The Timeout is used to automatically close the TCP/IP socket after a certain amount of seconds of inactivity on the port.

Note: A settings of 0 seconds means that the timeout is disabled. The TCP/IP socket will never be closed automatically and only one remote TCP/IP connection at the time is possible.

5.2.5 LCD Options

View and adjust the brightness and contrast of the LCD. Changes made here are persistent over power down and up.

5.2.6 Set RS232 Baud Rate

View and select the Serial Port's Baud rate from a set of preselected values from 1200 to 115,200 b/s (see Section 3.3).

Use the arrows to change the baud rate settings.

Default value is 9600b/s.

5.2.7 Set GPIB Address

View and select the GPIB's address. The default address is 9.

Not applicable for ENET (Ethernet) models.

6 Remote Operation

6.1 Introduction to SCPI

SCPI is a command structure that is based on the IEEE-488.2 specification which Dow-key has adapted to work with Ethernet, RS-232 and USB controls. The matrix has internal software loaded that uses SCPI command structure. SCPI is the abbreviation of Standard Commands for Programmable Instruments. These commands are standard messages for the (remote) control of programmable instruments, which are sent by the Ethernet and/or RS-232 and/or USB controller. The principal objective of SCPI is to make the programming of a test system easier for the user. When the basic concepts and command structure of SCPI is understood, it will be easy for the user to write or modify a control program for the matrix.
The Socket Type of the matrix is server while your remote control computer is the client.

NOTE: Not all commands for SCPI are compatible with Ethernet, RS-232 and USB, only the ones stated in this document.

6.2 Command Syntax Structure

[ROUTe]:SWITch<id>[:VALue] <number>|MAX

- *Square brackets* [ ] indicate optional keywords or parameters.
- *Braces* { } enclosure parameter choices with a command string
- *Triangle brackets* < > enclose parameters for which you must substitute a value.
- *Vertical bar* | separates multiple parameter choices.

The command syntax shows most commands as a mixture of upper and lower case letters. The upper case letters indicate the abbreviated spelling for the command. For shorter program lines, the abbreviated form is used. For better program readability, the long form is used. For example, in the above syntax statement, ROUT and ROUTE are both acceptable forms. Since both upper and/or lower case letters are acceptable, ROUTE, rout and Rout are all acceptable. Other forms, such as RO and ROU are not acceptable and will generate an error.

NOTE: Each command must be terminated with a carriage return (0×0D) followed by a line feed (0×0A).

e.g. ”ROUT:SWITx n\r\n”
“ ROUT:SWITx n; SWITx?\r\n”

Where “\r” stands for carriage return (0×0D) and “\n” stands for line feed (0×0A).

6.3 Command Separators and conventions

- A *colon* (:) is used to separate a command keyword from a lower level keyword.
- A *blank space* is used to separate a parameter from a command keyword.
- A *comma* (,) is used if a command requires more than one parameter.
- A *semicolon* (;) is used to combine multiple commands into one message string. Commands from the same *subsystem* are permitted to skip repeating the upper-level keyword.
  Eg. "*Route:Switch1 8; Switch2 5; Switch3 2*"
- A *colon* is used when linking commands from different subsystems into one message string, allowing a new upper-level keyword to be introduced. Since the keyword is optional, such keyword could also be omitted (see example 2).
  Only the first command requires the colon. Any subsequent commands of the same subsystem do not require the colon (see example 3).

  Ex. 1: "*Route:Switch1 8; Switch2 5; Switch3 2; System:Error?*"
  Ex. 2: "*Route:Switch1 8; Switch2 5; Switch3 2; :Error?*"
  Ex. 3: "*Route:Switch1 8; Switch2 5; Switch3 2; :Error?; Timeout 2; status?*"

- When linking multiple commands the maximum number of characters supported is 220. The limit of 220 characters is valid in transmission and receiving.
- All messages are in ASCII format (numeric values are represented in decimal format with exception of the MAC address which is expressed in hex format).
- Timing, sequences and action requirements are only shown where applicable and are under the TIMING sub-paragraphs on each command description.
- Any string returned by the matrix is terminated with a carriage return **(0×0D)** followed by a line feed **(0×0A)**.

  e.g. "ROUT:SWIT2?\r\n"

  will return

  "1\r\n"

  Where "\r" stands for carriage return (0×0D) and "\n" stands for line feed (0×0A).

6.4 Common Commands

The following contains the common commands of SCPI that the Ethernet controller is compatible with.
The possible error codes assume that the correct syntax is used and, in case of a multiple command string the string is not too long.
If these conditions are not met, any given command can generate these error codes: 3, 4, 30

6.4.1*IDN?

Syntax
*IDN?

Result
A string is returned which consists of the following parts:

Model

Model Matrix model number

Possible error codes
None

Example
"*IDN?"

Result
"MS-2U18S-1/6T-ENET"

6.4.2*OPC?

Syntax
*OPC?

Description
This query returns an ASCII character “1” when all pending operations have been finished.

Result
ASCII character “1”.

Possible error codes
None

Example 1
*OPC?

Result
“1”

Example 2
:SWIT1 4; SWIT2 4; *OPC?

Result
“0”

Timing
In example 2 the matrix did not have the time to execute the command. Hence a “0” is returned. A subsequent *OPC? will return a “1” as shown in example 1.
The timing to execute a command depends on the length of the command (in case of concatenated commands).
As a rule of thumb electromechanical switches require approximately 30ms to switch position. It is safe to consider some safety margin and increase this timing to 40-50 ms when developing the control software.

6.4.3 *RST

Syntax
*RST

Description
This command performs a device reset.
This will set the instrument so that all switches are in the default state.
For SPnT switches the default state is: all RF ports are open.
For a transfer switch the default state is: position 1 is closed.

Possible error codes
11, 12, 13

Timing
As a rule of thumb electromechanical switches require approximately 30ms to switch position. It is safe to consider some safety margin and increase this timing to 40-50 ms before issuing any other command after a *RST.

6.5 System Commands

The following contains the system commands of SCPI that the Ethernet and RS-232 control is compatible with.

6.5.1 SYST:ERR?

Syntax
SYSTem:ERRor?

Description
Query the instrument's error queue. A record of up to N errors is stored in the instrument's error queue. Errors are retrieved in first-in first-out (FIFO) order. The first error returned is the first error that was stored. Each additional error up to N is read by N subsequent queries (one for each error). For this instrument N=10. The error queue has to be read until no more errors are returned, otherwise the error status is not cleared.
The Error LED will also illuminate RED.

Note: some of the listed error codes are here for backwards compatibility with legacy products and other are reserved for future applications. Not all error codes are applicable to this matrix.

Result
String with the following syntax:
code, message
code: Numeric value with the error code (0 if no error).
Message: String with error message.

Example

"SYST:ERR?"
Result was "1, INVALID CHARACTER", check for more errors.
Description: This error is no longer supported. The error code is maintained and reserved for legacy purposes only.

"SYST:ERR?"
Result was "2, OUTPUT BUFFER OVERFLOW", check for more errors.
Description: This error is no longer supported. The error code is maintained and reserved for legacy purposes only.

"SYST:ERR?"
Result was "3, TOO MANY COMMANDS", check for more errors.
Description: The maximum of 220 characters per command line has been exceeded.

SYST:ERR?"
Result was "4, SYNTAX ERROR", check for more errors.
Description: There is a misspelling in your command or a non-numeric character was included in a command where a number should have been, or use of unrecognized symbols such as %, &, #, etc.

SYST:ERR?"
Result was "5, DATA OUT OF RANGE", check for more errors.
Description: The value transmitted is not acceptable.
Eg. 1: A non existing switch positions has been commanded. Sending *Route:Switch1 8*. When switch 1 is a SP6T (6 position switch)
Eg. 2: This error code is set if the IP address or MAC address is an invalid one. Sending SYSTEM:IPADDRESS 55.57.2 would generate this error code since 4 numbers are required for a valid IP address.

SYST:ERR?"
Result was "6, ILLEGAL PARAMETER VALUE", check for more errors.
Description: This error is no longer supported. The error code is maintained and reserved for legacy purposes only.

SYST:ERR?"
Result was "7, INPUT BUFFER UNDERFLOW", check for more errors.
Description: This error is no longer supported. The error code is maintained and reserved for legacy purposes only.

SYST:ERR?"
Result was "8, MATRIX SOCKET NOT AVAIL", check for more errors.
Description: This error is no longer supported. The error code is maintained and reserved for legacy purposes only.

SYST:ERR?”
Result was “10, SWITCH DID NOT RESPOND”, check for more errors.
Description: One of the switches did not respond to a position query.
E.g. CAN bus communication failure or damaged switch.

SYST:ERR?”
Result was “11, SWITCH’S RESPONSE INVALID”, check for more errors.
Description: A switch responded but with the wrong response code. This error is related to wrong internal CAN bus communication codes.

SYST:ERR?”
Result was “12, SWITCH’S POSITION INCORRECT”, check for more errors.
Description: One of the switches reported to be closed on a position different than what it was commanded to be.
E.g. Commanded position is 4, reported position is 3.

SYST:ERR?”
Result was “13, SWITCH’S POSITION UNKNOWN”, check for more errors.
Description: One of the switches reported to be closed on an unknown position. E.g. A defective / damaged switch.

SYST:ERR?”
Result was “20, MATRIX IS NOT CONFIGURED”, check for more errors.
Description: The configuration file (factory configuration) defining all switches configured inside the matrix has not been uploaded. The matrix does not ‘know’ what and how many switches to control.

SYST:ERR?”
Result was “21, CONFIGURATION FILE IS CORRUPT”, check for more errors.
Description: The configuration file (factory configuration) defining all switches configured inside the matrix is corrupted.

SYST:ERR?”
Result was “22, CONFIGURATION FILE DOES NOT MATCH INSTALLED SWITCHES”, check for more errors.
Description: The configuration file (factory configuration) defining all switch types configured inside the matrix does not match the actual installed switch types.
This error code is generated only at boot up and refers only to answering switches. A switch not answering to CAN messages would result into an error code 10.

SYST:ERR?”
Result was “23, MATRIX CONTAINS A 0 ID”, check for more errors.
Description: The matrix contains a switch that has not been assigned a valid CAN bus address. ID 0 is not a valid CAN bus address.

SYST:ERR?”
Result was “30, COMMAND UNRECOGNIZED”, check for more errors.

Description: This error code is generated when the commanded string does not contain any valid keyword (e.g. Route, System, *IDN?, *RST, ….) at all.

SYST:ERR?”
Result was “36, ID IS OUT OF RANGE”, check for more errors.

Description: A non existing switch ID has been commanded.
Eg. Sending *Route:Switch11 8*. When switch 11 does not exist.

SYST:ERR?”
Result was “50, UNABLE TO AQUIRE IP ADDRESS”, check for more errors.

Description: DHCP is enabled (ON), but the IP address could not be acquired dynamically.
Eg. Ethernet connection cable is disconnected.

SYST:ERR?”
Result was “51, FAN STALL”, check for more errors.

Description: On models with fans equipped with sensors, one or more fans have stalled (only when this alarm has been enabled at the factory).
Note: Not applicable for most models.

SYST:ERR?”
Result was “52, INTERNAL TEMPERATURE EXCEEDS THERSHOLD”, check for more errors.

Description: On models with temperature sensors, one or more temperature sensors has exceeded its alarm threshold (only when this alarm has been enabled at the factory).
Note: Not applicable for most models.

SYST:ERR?”
Result was “53, POWER SUPPLY FAILURE”, check for more errors.

Description: On matrices with redundant power supplies it will indicate that one of the power supplies does not operate.
E.g. Damaged power supply or blown fuse on the power supply.

Result was “0”NO ERROR””, No more errors, error queue is empty.

6.5.2 SYST:IPADDRESS?

Syntax
SYSTem:IPADDRESS?

Description
Returns the matrix IP address.

Result
xxx.yyy.zzz.aaa

Possible error codes
None

6.5.3 SYST:IPADDRESS xxx.yyy.zzz.aaa

Syntax
SYSTem:IPADDRESS xxx.yyy.zzz.aaa

Description
Sets system IP address to xxx.yyy.zzz.aaa.

Possible error codes
5

Factory default value
200.169.200.180

Power on behavior
Keeps last value

***RST effect**
None

Timing
In order for the new IP address to take effect the matrix needs to be power cycled.

6.5.4 SYST:TCPPORT?

Syntax
SYSTem:TCPPORT?

Description
Returns the matrix TCP Port number.

Result
n

Possible error codes
None

6.5.5 SYST:TCPPORT x

Syntax
SYSTem:TCPPORT x

Description
Sets the matrix TCP Port number to x.

Possible error codes
5

Factory default value
10

Power on behavior
Keeps last value

***RST effect**
None

Timing
In order for the new TCP Port to take effect the matrix needs to be power cycled.

6.5.6 SYST:GATEWAY?

Syntax
SYSTem:GATEWAY?

Description
Returns the matrix gateway address.

Result
xxx.yyy.zzz.aaa

Possible error codes
None

6.5.7 SYST:GATEWAY xxx.yyy.zzz.aaa

Syntax
SYSTem:GATEWAY xxx.yyy.zzz.aaa

Description
Sets matrix gateway address to xxx.yyy.zzz.aaa.

Possible error codes
5

Factory default value
200.169.0.0

Power on behavior
Keeps last value

***RST effect**
None

Timing
In order for the new Gateway address to take effect the matrix needs to be power cycled.

6.5.8 SYST:MASK?

Syntax
SYSTem:MASK?

Description
Returns the matrix subnet mask address.

Result
xxx.yyy.zzz.aaa

Possible error codes
None

6.5.9 SYST:MASK xxx.yyy.zzz.aaa

Syntax
SYSTem:MASK xxx.yyy.zzz.aaa

Description
Sets the matrix subnet mask address to xxx.yyy.zzz.aaa.

Possible error codes
5

Factory default value
255.255.255.0

Power on behavior
Keeps last value

***RST effect**
None

Timing
In order for the new Mask address to take effect the matrix needs to be power cycled.

6.5.10 SYST:MACADDRESS?

Syntax
SYSTem:MACADDRESS?

Description
Returns the matrix mac address.in hex format

Result
aa.bb.cc.dd.ee.ff

Possible error codes
None

6.5.11 SYST:SERIALNUMBER?

Syntax
SYSTem:SERIALNUMBER?

Description
Returns the matrix serial number.

Result
n

Possible error codes
None

6.5.12 SYST:TIMEOUT?

Syntax
SYSTem:TIMEOUT?

Description
The Timeout is used to automatically close the TCP/IP socket after a certain amount of seconds of inactivity on the port.

Returns the Time out setting for the TCP/IP connection (n is in seconds).
n = 0 means no Time out is set.

Result
n

Possible error codes
None

6.5.13 SYST:TIMEOUT x

Syntax
SYSTem:TIMEOUT x

Description
The Timeout is used to automatically close the TCP/IP socket after a certain amount of seconds of inactivity on the port.

Sets the Time out setting for the TCP/IP connection (n is in seconds).
x = 0 means no Time out is set.

Possible error codes
5

Factory default value
0

Power on behavior
Keeps last value

***RST effect**
None

6.5.14 SYST:STATUS?

Syntax
SYSTem:STATUS?

Description
This command will return all Switch positions, Local/Remote mode, Power supply status, High temperature alarm status, Fan stall alarm and Errors list separated by a semicolon.

Note 1: Power supply status, High temperature alarm status and Fan stall alarm are only returned if enabled.
(Most models do not have redundant power supplies, temperature sensors and fans and therefore will not report this status information)

Note 2: Multiple instances of the same error code will appear multiple times. E.g. if two different switches fail to respond to CAN messages, two instances of error 10 will be returned.
But multiple error instances of the same switch will appear only once.

Result
"SWITx y;SWITx y;SWITx y;…….;SWITx y;LOC;PWR1 OK;PWR2 FAULT; ERRORS 5,3,0"

SWIT = Switch
X = Switch number (ID)
Y = Switch position
LOC = Local mode
REM = Remote mode
PWR1 = Power supply 1
PWR2 = Power supply 2 (Only for systems with dual power supplies)
TEMP1= Temperature sensor 1 (Only if temp sensor 1 is enabled)
TEMP2= Temperature sensor 2 (Only if temp sensor 2 is enabled)
TEMP3= Temperature sensor 3 (Only if temp sensor 3 is enabled)
TEMP4= Temperature sensor 4 (Only if temp sensor 4 is enabled)
FAN1 = Fan 1 (Only if Fan sensor 1 is enabled)
FAN2 = Fan 2 (Only if Fan sensor 2 is enabled)
FAN3 = Fan 3 (Only if Fan sensor 3 is enabled)
FAN4 = Fan 4 (Only if Fan sensor 4 is enabled)
ERRORS = Error codes (Each number corresponds to a specific error code described in the user manual. Not all error codes apply to the matrix).

Possible error codes
None

6.5.15 SYST:SCREENSAVER?

Syntax
SYSTem:SCREENSAVER?

Description
This command will return the screen saver time settings n (n is in minutes).
Possible values for n are 0, 2, 3, 4, 5, ……
Note that 1 is not a valid value.

0 = Screen saver is disabled

Possible error codes
5

Factory default value
5

Power on behavior
Keeps last value

***RST effect**
None

6.5.16 SYST:SCREENSAVER x

Syntax
SYSTem:SCREENSAVER x

Description
This command will set the screen saver time settings x (x is in minutes).
Possible values for x are 0, 2, 3, 4, 5, ……
Note that 1 is not a valid value.

0 = Screen saver is disabled

Possible error codes
5

Factory default value
5

Power on behavior
Keeps last value

***RST effect**
None

6.6 Switch [Module] Command Set

The following contains the switch [module] commands of SCPI that the Ethernet control is compatible with.

6.6.1 :SWITch<id>[:VALue] <number>

Syntax

[ROUTe]:SWITch<id>[:VALue] <number>

Description

This command is used to control the position of the switches. The switch specified by the numeric suffix <id> is set to position <number>. Switch positions are specified in a 0 to N fashion, therefore legal values for <number> are from 0 to the maximum number of position for the switch. For example, a SP10T switch has 11 positions, 0 thru 10. Position 0 means the switch is set to its default position.

For most switches the default position is pos 0 (open switch). So in case of a SP10T switch this means no position is closed.

In case of a transfer switch, since it does not have an open position, the default position is pos 1. So commanding it to pos 0 will close it to position 1.

6.6.2 Setting switch x to position n

x = switch [module] address.
n = position to set and must be within the switches parameter.
(Example: SP10T valid positions are 0 thru 10 only).

Examples:

- ROUTE:SWITCHx n
- ROUT:SWITCHx n
- ROUTE:SWITx n
- ROUT:SWITx n
- :SWITCHx n
- :SWITx n
- ROUTE:SWITCHx:VALUE n
- ROUTE:SWITCHx:VAL n
- :SWITx:VAL n

Possible error codes
5, 10, 12, 13

Factory default value
N.a.

Power on behavior
Keeps last value

***RST effect**
SP6T switch: will open all positions
Transfer switch: will close position 1

Timing
The timing to execute a command depends on the length of the command (in case of concatenated commands).
As a rule of thumb electromechanical switches require approximately 30ms to switch position. It is safe to consider some safety margin and increase this timing to 40-50 ms when developing the control software.
Multiple switch commands are not executed in a sequential manner but rather in parallel.

6.6.3 Requesting Switch x current position

x = switch address.

Examples:
- ROUTE:SWITCHx?
- ROUT:SWITx?
- :SWITx?

Result:
Returns the current position of switch x.

Possible error codes
10, 11, 12, 13

Timing
The timing to execute a command depends on the length of the command (in case of concatenated commands).
As a rule of thumb electromechanical switches require approximately 30ms to switch position. It is safe to consider some safety margin and increase this timing to 40-50 ms before issuing this command after setting a new switch position.
Multiple switch commands are not executed in a sequential manner but rather in parallel.

6.7 DHCP Command Set

The following contains the DHCP (Dynamic Host Configuration Protocol) commands of SCPI that the Ethernet control is compatible with.

6.7.1 SET:DHCP ON or SET:DHCP OFF

Syntax
SET:DHCP ON I OFF

Description
Turns DHCP mode ON or OFF

Possible error codes
5

Factory default value
OFF

Power on behavior
Keeps last value

***RST effect**
None

Timing
In order for the new DHCP settings to take effect the matrix needs to be power cycled.

6.7.2 GET:DHCP

Syntax
GET:DHCP

Description
Returns DHCP mode

Result
ON
or
OFF

Possible error codes
None

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RS232, USB and Ethernet Command description for standard matrices

	Command Syntax	Response	Action
1	*IDN?	MS-1U18S-4/6-ENET	Returns string in 'Model Name' in the configuration file. As a minimum will have model name. Could also have: Vendor, model, serial number, firmware revision (The response shown in this table is just an example).
2	*OPC?	1 or 0	Gives 1 if previous operation was completed and gives 0 if previous operation is still not complete.
3	*RST		Puts all switches in the default position. (Transfer switches in pos.1. Most other switches in pos. 0 = open).
4	ROUTE:SWITCHx y or :SWITCHx y		Closes position y on switch x (N.B.: on SP12T x is 1)
5	ROUTE:SWITCHx? or :SWITCHx?	n	Gives current position of switch x (N.B.: on SP12T x is 1)
6	SET:DHCP ON or SET:DHCP OFF		Turns DHCP mode ON or OFF
7	GET:DHCP	ON or OFF	Returns DHCP mode
8	SYST:IPADDRESS?	xx.yy.zz.aa	Returns system IP address
9	SYST:IPADDRESS xx.yy.zz.aa		Sets system IP address to xx.yy.zz.aa
10	SYST:TCPPORT?	n	Returns TCP port number
11	SYST:TCPPORT x		Sets TCP port number to x
12	SYST:GATEWAY?	xx.yy.zz.aa	Returns system gateway address
13	SYST:GATEWAY xx.yy.zz.aa		Sets system gateway address to xx.yy.zz.aa
14	SYST:MASK?	xx.yy.zz.aa	Returns system subnet mask address
15	SYST:MASK xx.yy.zz.aa		Sets system subnet mask address to xx.yy.zz.aa
16	SYST:MACADDRESS?	xx.yy.zz	Returns system MAC address
17	SYST:SERIALNUMBER?	n	Returns system serial number
18	SYST:TIMEOUT?	n	Returns Time out setting for TCP/IP connection (n is in seconds)
19	SYST:TIMEOUT x		Sets Time out setting for TCP/IP connection (x is in seconds)
20	SYST:ERR? or SYST:ERROR?	-4,SYNTAX ERROR	Returns system error number and error description. (The response shown in this table is just an example).
21	SYST:STATUS?	SWITx y;SWITx y;SWITx y;… ;SWITx y;LOC;PWR1 OK;PWR2 FAULT; ERRORS 5,3,0	This command will return all Switch positions, Local/Remote mode, Power supply status and Errors list in the error buffer separated by a semicolon.
22	SYST:SCREENSAVER?	n	Returns time setting for the screen saver (n is in minutes)
23	SYST:SCREENSAVER x		Sets time setting for the screen saver (x is in minutes)

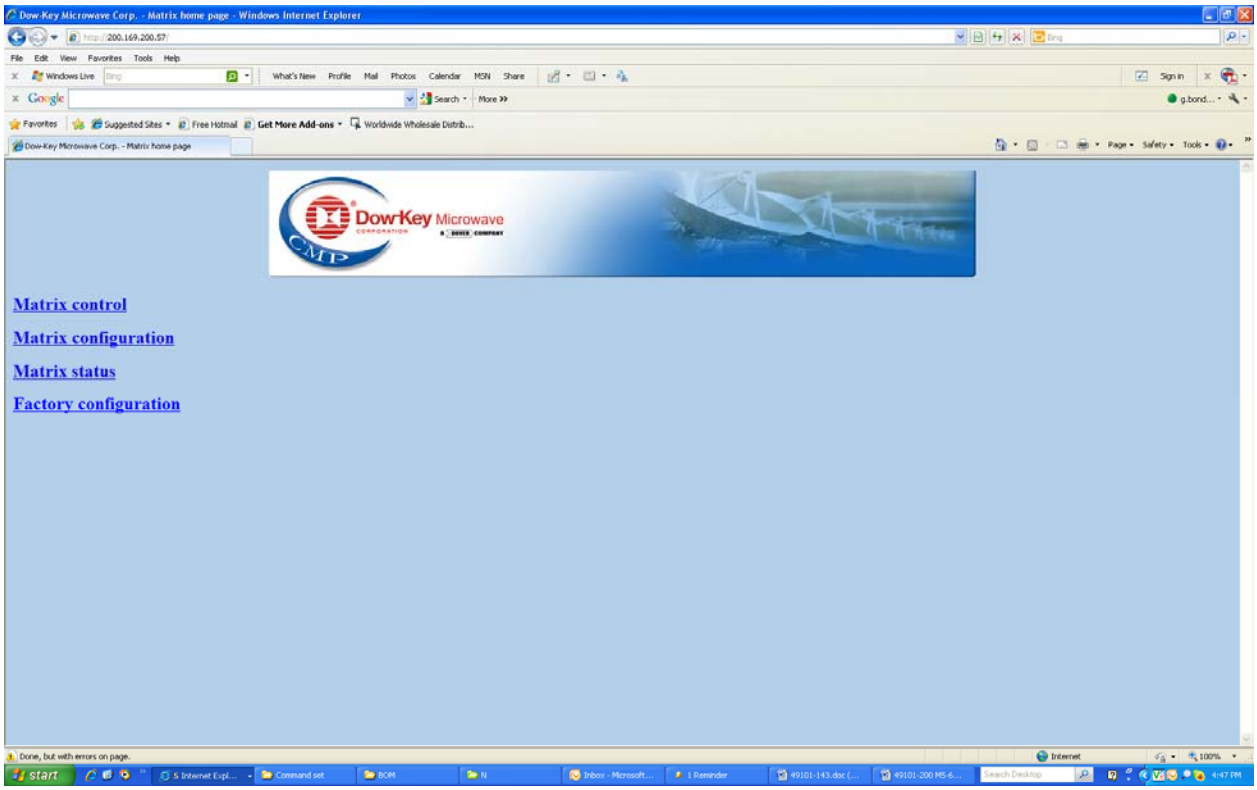
Note:

1. Commands are **NOT** case sensitive.
2. Every command and response on the Ethernet and serial port should have "\r\n" Carriage return (0x0D) and Line Feed (0x0A) at the end.
3. Multiple commands with same header can be given in a single command line.
   e.g. SYST:IPADDRESS?;TCPPORT?;SERIALNUMBER 2 or ROUTE:SWITCH1 2;SWITCH1?;
   note that the commands have to separated by '**;**'
4. The default settings for the Ethernet interface are:
   a. IP Address: n.a.
   b. IP Port number: 10
   c. Gateway address: 200.169.200.5
   d. Subnet mask: 255.255.255.0
   e. In command SYST:TIMEOUT? The returned value n is in seconds. The default value is 0. 0 = no timeout.
   f. by sending command $/FILE
   g. Reboot the matrix
5. In command SYST: SCREENSAVER? and SYST:SCREENSAVER x, the value n and x is in minutes. The default value is 5 (minutes). 0 = no screen saver. Valid values for x are: 0, 2, 3, 4, 5, 6,….

7 Web Page Server (HTTP)

7.1 Web Page Server Control

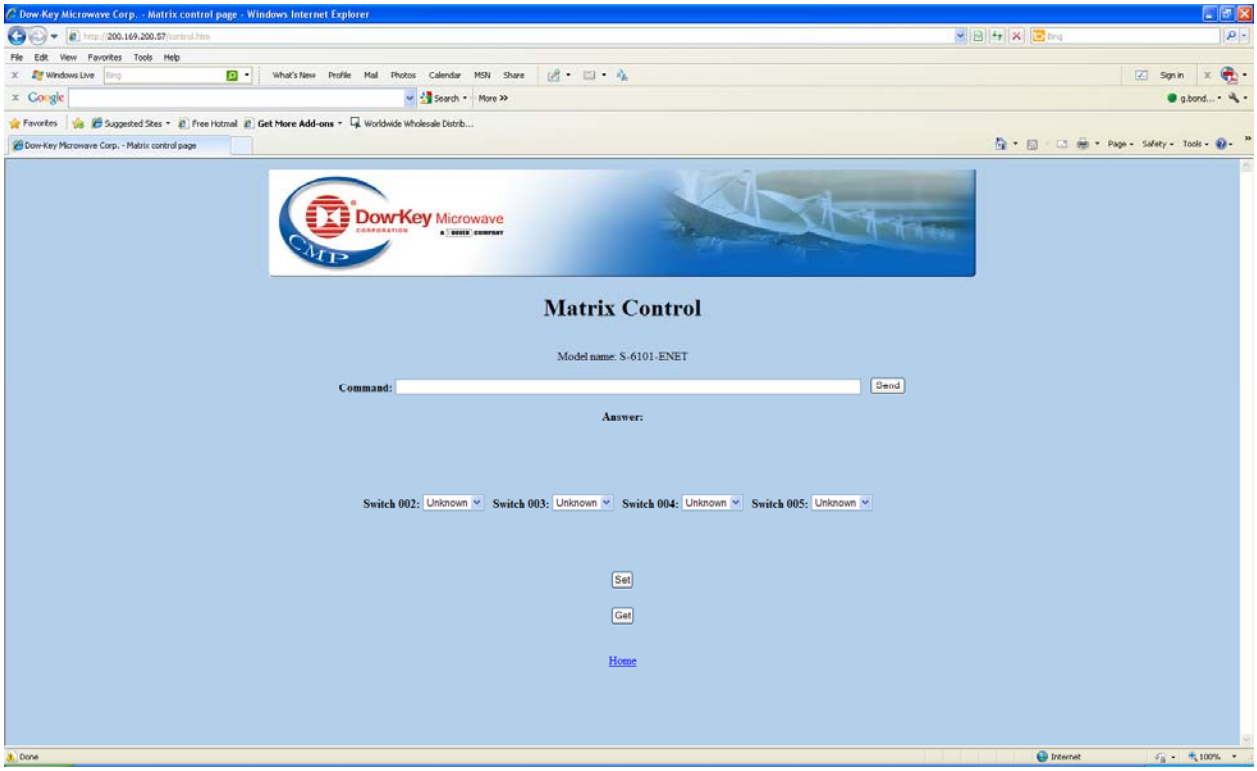
The matrix may be controlled by way of web pages served by the matrix over its Ethernet port. With the matrix properly connected to an Ethernet (see Section 4), type the matrix's current IP address into a browser's Address Bar. The following page should appear:



The Operator may select '**Matrix Control**', '**Matrix Configuration**', or '**Matrix Status**'; '**Factory Configuration**' is reserved for the sole use by Dow-Key Microwave.

7.2 Matrix Control

Clicking on '**Matrix control**' will show the below page.



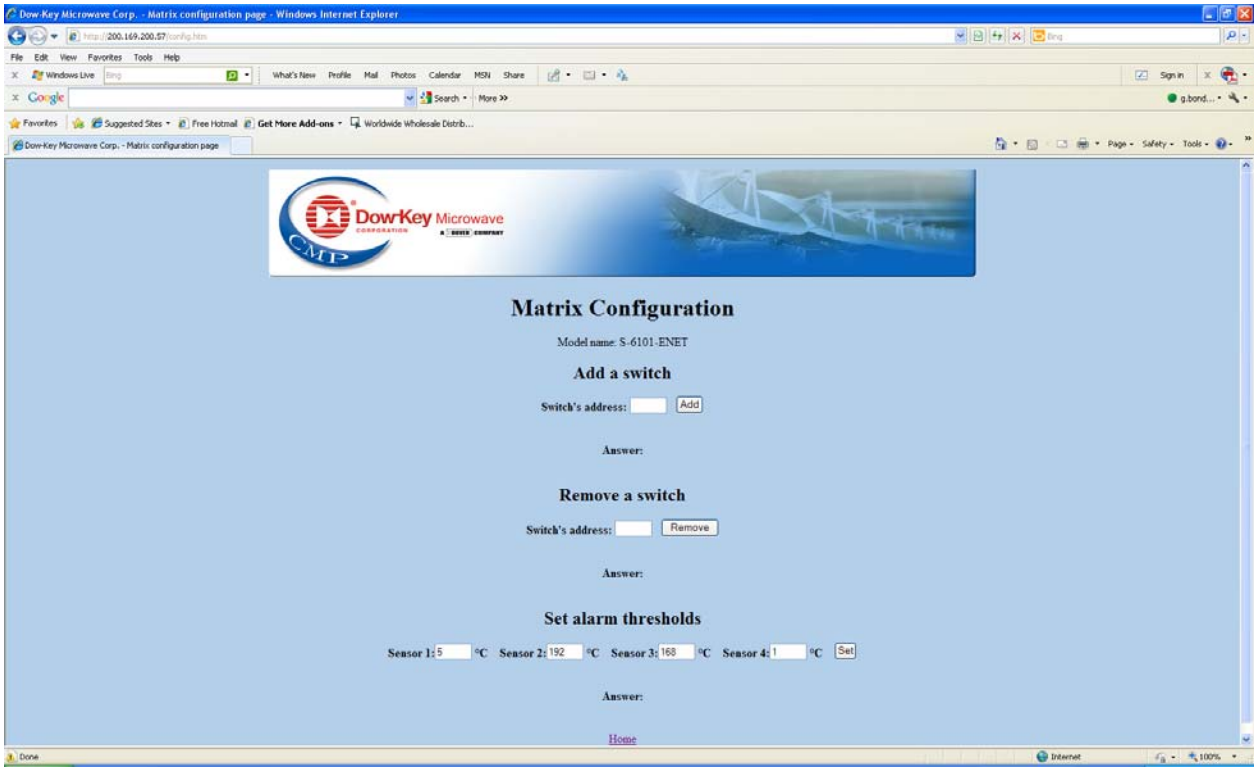
Remote mode commands may be typed into the Command text box and then clicking on the '**Send**' button. See section 6 for the remote command list and its syntax.

If the command implies that the matrix responds (for instance when querying the matrix) the matrix's response will be shown next to the '**Answer:**' label.

The bottom half displays the current position of all switches currently configured to the matrix. Their positions may be set by selecting one from a switch's drop down box and then clicking '**Set**'. Clicking on the '**Get**' button returns the position of all switches.

7.3 Matrix Configuration

Clicking on '**Matrix configuration**' will show the below page.



! Important Note:

The matrix controller is designed to offer the maximum expandability and flexibility possible and therefore has features common to other Dow-Key matrix models. The here described 'Add a Switch' and 'Remove a Switch' features are some of those that, although available and fully functioning, should only be used if needed and appropriate.

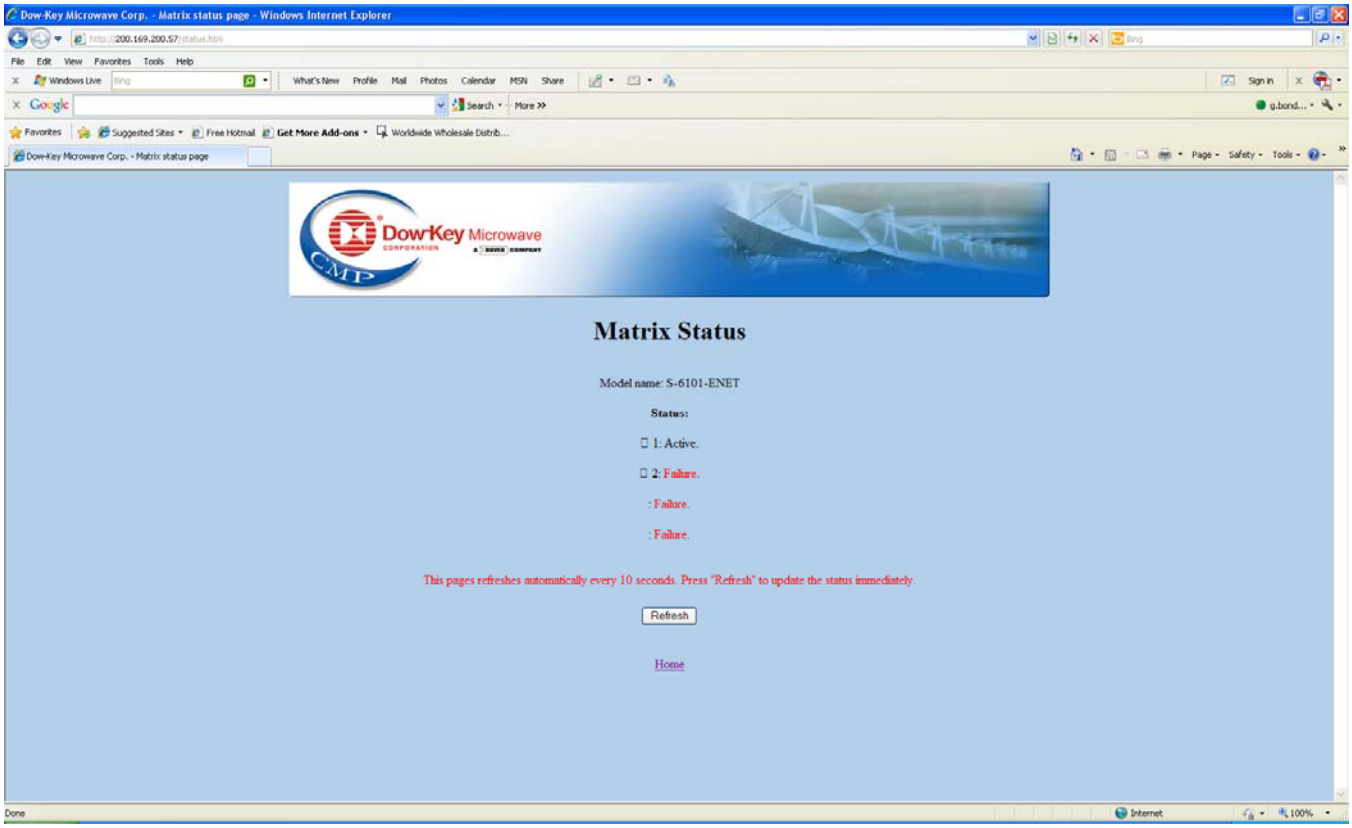
Switches may be added and deleted from the Matrix Configuration using these commands.

For those matrix models with a custom or fixed RF configuration (in other words where the internal RF switches and its connections are defined on a custom bases or are established and fixed by design), no switch shall be added or removed from the matrix configuration. Not following this instruction will result in a non working matrix!

This page also allows to set the temperature alarm threshold of the temperature sensors. This feature is disabled by setting all 4 temperature alarm thresholds to 0°C.
Most matrices do not contain any devices that produce significant heat, therefore these models do not feature any temperature sensors. Leave all 4 temperature alarm thresholds to 0°C.

7.4 Matrix Status

Clicking on '**Matrix status**' will show the below page.



This page displays the current status of alarm sources (power supplies, fans, temperatures).

If the matrix does not have a redundant power supply, fans with stall sensors and temperature sensors, than this page will not display any of this information.

Appendix A

Technical Specifications

Model:	MS-1U18S-4/6-ENET
Configuration:	Four SP6T switches mounted on the rear panel
RF Connectors:	SMA (on rear panel)
Frequency range:	DC to 18 GHz
Return loss (VSWR) Insertion loss Isolation RF Power:	

Frequency (GHz):	**DC - 3**	**3 - 8**	**8 - 12.4**	**12.4 - 18**
VSWR (Ratio max):	1.20 : 1	1.30 : 1	1.40 : 1	1.50 : 1
Insertion Loss (dB max):	0.2	0.3	0.4	0.5
Isolation (dB min):	80	70	60	60
RF Power (Watts CW max):	125	90	75	60

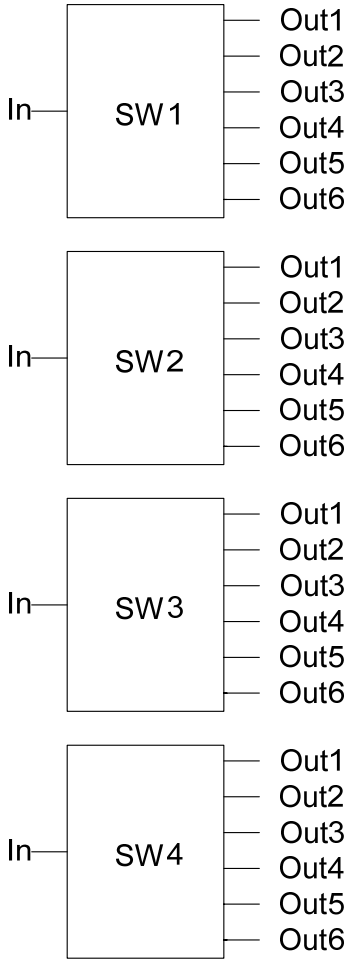
Impedance:	50 Ω
Switching Speed:	50ms (per switch)
Operating Temp:	0 to 50 degrees C
Switch Type:	Four normally open SP6T. Switch p.n. 565-5208-3-ROHS
Line Voltage:	120-240 VAC, 50-60 Hz
Control Interfaces:	Ethernet via RJ-45 Connector RS-232 via 9-pin D-Sub female connector CAN Bus via 4 pin XLR female connector USB type A (used as 'virtual' serial port)
RS-232 Settings:	Settable at 1200, 2400, 4800, **9600** (default), 19200, 38400, 57600,115200 bits/sec, 8 bit data, no parity, 1 stop bit
Dimensions:	1.72" H x 19" W x 14.75" D (without handles and rear connectors)

Appendix B

RF Configuration

Model: MS-1U18S-4/6-ENET

Four normally open SP6T switches (Dow-Key part number: 565-5208-3-ROHS) mounted on the rear panel.
The switches are not interconnected RF wise as shown below.



Note that all switches are bi-directional. Hence each RF port can be considered an input or an output.